A Decision Support Tool for Urban Energy Policy

An urban morphological approach to figure out the energy performance of existing developments

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Introduction

Although the world-wide interest of academic studies and policymakers on the energy matter is mainly focused on buildings, the management of energy performance of existing urban development, in the last 20 years, become an important and frequently debated issue both in scientific literature and public administration practice (among others [1-5]). According to Alberti (1999), the study of urban pattern in relation to environmental processes remains an open issue, especially the operationalization of some research findings into the planning practices.
The role of spatial planning in mitigating the effects of greenhouse gas emissions due to fossil fuels and adapting the current urban conditions, is internationally recognised (among others [6-9]. Complexities and differences between professional, technical and political support from each administrations exist, increasing the implementation gap of urban and environmental policies (among others [10-13]).
In such a context, the analysis of relationships between urban form and energy performance of transport and housing stock sectors, could be an useful tool to increase the knowledge of urban interactions and support decision processes, especially in strategic planning.

The context

The pursuit of energy efficiency goals, which must be considered as the other face of climate change, integrates the wider debate on how the urban form affects energy pressure and urban environment processes. It concerns also the operationalisation of the research findings into the urban planning practices and policy making actions.
A cross-cutting approach able to consider actions in multiple fields of urban interest and their integration into are widely recommended both by International organizations, such as EU, UN, OECD, and scholars. This endeavor requires multiple efforts at all levels, from the national to the local one.

Climate change literature, supported by urban ecosystems approach and integrated with urban theory affirms that the city and the local level are the scales where proper measures can be deveoped and implemented [14,15].
Indeed, assuming in accordance with urban scholars that energy has a spatial dimension, several physical factors contribute, in a strong interaction, to energy pressure: urban shape and urban size, population density and urban sprawl, microclimate conditions, built features and mobility [3,4,16-19].
In the perspective of designing measures to manage and reduce the energy consumption at the city level and to increase awareness of the complexity of urban dynamics among local administrators, politicians and planning practioners, a decision support tool becomes necessary. In particular, it is crucial to guide the Local Administrations towards incisive choices at the strategic level of urban and municipal energy plan, to be oriented to the reasoned construction of project and actions.

The decision support tool

A critical and pragmatic review of urban planning literature, which has addressed the described issues with theoretical and empirical studies, is the basis for the correlations between urban morphology (also known as urban form or urban pattern) and energy performance of mobility and existing buildings. The hypothesis underlying the design of the tool consider that, in accordance with Alberti, 1999, the available evidence on the relationships between energy and urban form, however, are mixed and contradictory. In fact, she said that the study of urban morphology in relation to environmental processes is still too fragmentary and lacks a theoretical framework to answer such a complex question [20].
Moreover, the aggregated impacts, concerning cumulative and synergistic environmental effects, are not dealt with by the reviewed literature, thus increasing the lack of a considerable consensus on the real implications of such a theoretical context on the urban planning and policy.
The adoption of both an urban morphological and interpretative approach would take into consideration a semi-quantitative determination of urban/energy performance configurations according to the complexity and uncertainty over the quantitative outputs of studies and explorations.
The proposed tool is based on the strength of previous considerations and consists of a limited number of standardized urban typologies following the more probable combination of urban factors, such as population and housing density, housing size and type, with the interpretation of probable energy performance. Determined the climatic and orographic data and given the urban factors which can feature the form, a graphical interpretation corresponding to the energy performance of different urban sectors is assigned to each urban typology.
In addition, some reflections and simulations on the unit of measurement of energy performance regarding the urban typologies have been done. There has questioned whether it is better to consider the consumption per capita, per square meter of housing or per square meter of land to reflect the debate between building physicists and urban planner and the consequent policies and tools to control the parameter.

The comparison between the standardized typologies of urban areas is carried out firstly with the same number of inhabitants but with different urban shape and size (for the pro capita consumption) and later with the same urban shape and size but variable numbers of inhabitants (for the other two options).
This support to decision making has been tested on the case of Trento, a middle city in northern Italy, by doing a comparison between the standardized urban typologies and the current scenario, having access to the dataset of the municipal energy company.

Discussion and conclusions

The paper presents and discusses the interpretation of the original problem of energy efficiency in urban areas on the basis of literature and administrative practices and praxis following a pro-actions perspective.
The urban complexity and its relations with environmental processes and the use of natural resources is a current discussion which has no immediate answers but stressing the necessity of urgent actions. The decision support tool proposed suggests a manner to combine a semi-quantitative approach with an urban morphology view, oriented to project-and-actions of local administrations.
The case study of Trento points out both the features and the limitations of the work. Relating the results to the current academic knowledge in the field and the local administrative context, the study can contributes to increase the skills on energy management in urban development but it needs an officially accepted collocation and integration within the planning initiatives.

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